REMARKS/ARGUMENTS

Reconsideration of the present application, as amended, is respectfully requested.

The January 16, 2004 Office Action and the Examiner's comments have been carefully considered. In response, claims are amended and remarks are set forth below in a sincere effort to place the present application in form for allowance. The amendments are supported by the application as originally filed. Therefore, no new matter is added.

CLAIM OBJECTIONS

In the Office Action claims 17-19 are objected to because of certain informalities. Specifically, the Examiner points out that the spelling of a word in claims 17-19 may be improper. In response, claims 17-19 are amended in a sincere effort to overcome the objection to these claims. In view of the amendment of claims 17-19, reconsideration and withdrawal of the objection to claims 17-19 are respectfully requested.

PRIOR ART REJECTIONS

In the Office Action, claims 16-19 are rejected under 35 USC 103 as being unpatentable over USP 5,866,911 (Baer) in view

of USP 6,272,376 (Marcu et al.) and USP 6,522,345 (Alexander et al.).

Claim 16, which corresponds to the embodiment shown in Fig. 5 of the present application, is directed to a laser scanning microscope including a pulse laser unit (21) configured to oscillate a pulse laser beam to excite a sample (23), a scanning mirror (22) configured to scan the pulse laser beam, a photodetector (36) configured to detect light from the sample and output an analog detection signal, a sampling control circuit (33) which receives a pulse oscillation signal from the pulse laser unit and generates a trigger signal delayed by a predetermined time, a pulse generator (45) which receives the trigger signal and generates sampling pulse signals for each trigger signal for a predetermined output period, an A/D converter (27) which converts the analog detection signal from the photodetector to digital data in synchronism with each of the sampling pulse signals, and a memory (29) which stores the digital data from the A/D converter.

Referring to FIG. 5 and FIGS. 6A-6F of the present application, an embodiment of the present invention will be described.

In this embodiment, a pulse signal output from a pulse generator 45 is used as the sampling clock signal for the A/D converter 27. The pulse generator 45 generates a pulse signal as shown in FIG. 6E in synchronism with the trigger signal 38 output from the delay circuit 37. The frequency fp of the pulse signal and the output period ($\Delta t2$) of each pulse of the pulse signal are set arbitrarily using the external input circuit 39. More specifically, the A/D converter 27 executes sampling, using, as a sampling clock signal, a trigger signal from the delay circuit 37, and executes sampling only within each output period ($\Delta t2$) (see FIG. 6E). Accordingly, the fluorescent signal, which attenuates with time, can be reliably sampled, without missing its peaks, by adjusting the delay time ($\Delta t1$) of the delay circuit 37 and the output period ($\Delta t2$) of each pulse of the pulse generator 45. Moreover, timing adjustment can be executed so that no sampling is executed where no fluorescent signal is generated. For example, when applying the above-described structure to a laser scanning microscope that uses a two-photon process, if sampling is executed one hundred times during the generation of one pulse of a laser beam, the above structure can be used by setting the output period ($\Delta t2$) at 10 ns or less and setting the frequency of the pulse signal of the pulse generator

45 at about 10 Ghz, since, in the two-photon process, a laser beam has a pulse frequency of 80 MHz and a pulse width of 100 fs.

As is evident from the above, a brighter image can be obtained by reliably sampling the fluorescent signal than in the case of executing sampling which is not synchronized with laser oscillation. Also, there may be a case where the frequency of emission of fluorescence is low, and hence the fluorescent signal is not always generated each time a laser pulse is generated. Even in this case, the fluorescent signal can be acquired efficiently by sampling it in synchronism with laser oscillation. Furthermore, since the fluorescent signal is reliably sampled without missing its peak(s), and is stored in the memory 29, digital processing using the digital data, such as digital integration of the fluorescent signal, analysis of the maximum value of the fluorescent signal, analysis of the time constant of the fluorescent signal, etc., can be executed. In addition, since the sampling is not executed when a fluorescent signal is not generated, only necessary sampled data can be stored in the memory 29, thereby reducing the memory capacity. Therefore, the remaining memory capacity can be effectively used.

Baer teaches a scan optical system such as a confocal laser microscope wherein a beam of light is focused to a spot in a

specimen to excite a flourescent species or other excitable species located at the spot. The effective size of the excitation is made smaller than the size of the spot by providing a beam of light having a wavelength adapted to quench the excitation of the excitable species.

The microscope defined by amended claim 16 has the following advantages. By delaying the start of sampling by a predetermined time period, the peak of fluorescence is detected (the start of sampling is adjusted to coincide with fluorescence) and by generating two or more sampling pulses for each pulse of the pulse laser and detecting the intensity of fluorescence using each sampling pulse, changes in the intensity of fluorescence over time can be detected. Baer does not disclose, teach or suggest the advantages set forth above.

In the Office Action, the Examiner acknowledges that the microscope of Baer lacks the equipment for fluorescence lifetime measurements including an A/D converter which converts the photodetector detection signal to digital data in synchronism with each of a plurality of sampling pulse signals generated by a pulse generator for each trigger signal received from the sampling control circuit. The Examiner contends, however, that equipment for fluorescence lifetime measurements such as

conventional commercially available digital oscilloscopes are well known in the art. The Examiner points to USP 6,272,376 (Marcu et al.) and USP 6,522,345 (Alexander) to support his position. The Examiner states that it would have been obvious to one of ordinary skill in the art at the time the invention was made to provide additional equipment such as a conventional commercially available digital oscilloscope in the microscope of Baer in order to obtain fluorescence lifetime measurements.

The present invention is not a mere combination of a laser scanning microscope with a commercially available digital oscilloscope as suggested by the Examiner.

The pulse generator of the present invention generates sampling pulse signals for each trigger signal for a predetermined output period. The A/D converter of the present invention converts the analog detection signal from the photodetector for digital data in synchronism with each of the sampling pulse signals (see claim 16, lines 11-15). Accordingly, only the actually significant detection signal within a predetermined period of time after the trigger signal is converted into digital data. The obtained digital data can be used for analysis of a subsequent stage without further processing.

If Marcu et al. and Alexander et al. are combined with Baer so as to convert the detection signal from the photodetector with a commercially available digital oscilloscope as suggested by the Examiner, the A/D converter and the pulse generator provided in the digital oscilloscope would convert the detection signal at any time (sequentially). The digital oscilloscope would not convert the detection signal within a predetermined period of time after the trigger signal is converted to digital data. Thus, the process of extracting the actually significant data (i.e. data of the trigger signal for a predetermined output period) from the obtained digital data would have to be performed. This processing should also be performed inside the digital oscilloscope. For this reason, the digital oscilloscope would have the structure of managing and extracting the desired data corresponding to the sequential digital data stored in the memory. The present invention does not require such structure.

In a digital oscilloscope as taught in Marcu et al. and Alexander et al., sampling pulses are generated at any time. In the present invention, however, sampling pulses are generated during a period required for data acquisition only (see claim 16, lines 11-16).

That is, the present claimed invention as defined by new claim 16 is patentable over Baer, Marcu et al. and Alexander et al. because the references do not disclose, teach or suggest, when taken either alone or in combination, inter alia, a laser scanning microscope including:

1. a sampling control circuit which receives a pulse oscillation signal from the pulse laser unit and generates a trigger signal delayed by a predetermined time; and/or

2. a pulse generator which receives the trigger signal and generates sampling pulse signals for each trigger signal for a predetermined output period; and/or

3. an A/D converter which converts the analog detection signal provided by the photodetector to a digital signal in synchronism with each of the sampling pulse signals (see claim 16 lines 8-16).

In view of the foregoing, claim 16 and claims 17-19 which are dependent thereon and further define and limit the invention defined by claim 16 are patentable over the cited references under 35 USC 102 as well as 35 USC 103.

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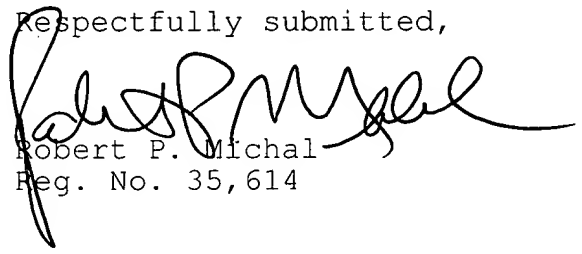
If the Examiner disagrees with any of the foregoing, the Examiner is respectfully requested to point out where there is support for a contrary view.

Entry of this Amendment, allowance of the claims, and the passing of this application to issue are respectfully solicited.

If the Examiner has any comments, questions, objections or recommendations, the Examiner is invited to telephone the undersigned at the telephone number given below for prompt action.

Respectfully submitted,



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Encl.: Petition for Extension of Time